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Indian Standard
TEST CODE FOR AGRICULTURAL DISCS

UDC 631·312·021·6—631·51·021 ; 620·1

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TEST CODE FOR AGRICULTURAL DISCS

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Indian Standard
TEST CODE FOR AGRICULTURAL DISCS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 July 1979, after the draft finalized by the Soil Working Equipment Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 The discs are used as soil engaging component in different agricultural machinery. Being the soil engaging component, discs wear out faster than other components and they have to be replaced very often. To ensure interchangeability, necessary dimensions of concave type and flat type discs have been specified in IS : 4366 (Part I)-1972* and IS : 4366 (Part II)-1972†. While formulating these standards, the committee had felt that standard procedure for testing of these discs should also be prepared in due course. Further the committee had considered in details the question of prescribing limits for deflection and impact, but their limits could not be prescribed since the test procedure for these two characteristics needed elaboration and specificity. This standard also includes the method of testing for deflection and impact. It is hoped that on the basis of these standardized methods reliable data would be compiled on a larger number of discs to facilitate the stipulation of limits for deflection and impact in IS : 4366 (Part I)-1972* and IS : 4366 (Part II)-1972† at later stage.

0.3 This standard is, by and large, based on the procedure followed at the Tractor Training and Testing Station, Budni.

0.4 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960‡.

1. SCOPE

1.1 This standard prescribes the method for testing of the agricultural discs.

---

*Specification for agricultural tillage discs: Part I Concave type (*first revision*).

†Specification for agricultural tillage discs: Part II Flat type (*first revision*).

‡Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 4366 (Part I)-1972* and IS : 4366 (Part II)-1972† shall apply.

3. GENERAL

3.1 The tests recommended below shall be carried out at the testing station in the laboratory:

a) Visual observations;
b) Dimensional measurement;
c) Flatness, eccentricity and wobble;
d) Hardness;
e) Chemical composition of the material;
f) Metallographic analysis of the material;
g) Deflection; and
h) Impact.

NOTE — Testing of the disc for deflection, impact and metallographic shall be done only for compilation of data, whereas visual observations, dimensional measurement, flatness, eccentricity and wobble, chemical analysis of material and hardness shall be measured to check the conformity of the product with the relevant Indian Standards.

4. SELECTION OF SAMPLE FOR TEST

4.1 Selection of Sample — A minimum of 10 discs and maximum of 15 discs shall be selected out of a lot of minimum 100 discs at random from the series production by the authorities of the testing station with the agreement of the manufacturer. It would be the responsibility of the manufacturer to ascertain that discs selected for testing are complete in all respects. The manufacturers shall supply literature and detailed drawing. The manufacturers shall also supply the specification sheet duly filled in as given in Appendix A.

5. VISUAL OBSERVATIONS

5.1 The disc obtained for testing should be serially numbered. The discs shall be visually examined in order to check the provisions for anti-corrosive coating, presence of burrs, scales, cracks etc, on the surface of disc and hair lining on the edge of the disc. The observations should be recorded in Appendix B. The information marked on discs shall also be indicated.

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*Specification for agricultural tillage discs: Part I Concave type (*first revision*).

†Specification for agricultural tillage discs: Part II Flat type (*first revision*).

6. DIMENSIONS CHECKING

6.1 The following dimensions appropriate to the type of discs, shall be checked and reported in *pro forma* given in Appendix C. The conformity or otherwise of the dimensions with the relevant specifications shall also be reported.

6.1.1 *Diameter* — Measure the diameter of the disc in millimetres by placing the edge of the measuring rule or proper size vernier calliper in contact with the edges of the disc and passing over the centre of the disc. Repeat the same at least at four places in the same disc. The points should be equidistant.

6.1.2 *Thickness of the Disc* — Measure the thickness of the disc with the help of point micrometer at four places. Before measuring the thickness, all the paint should be removed. It is advisable to measure the thickness at centre hole side up to a distance of 50 mm.

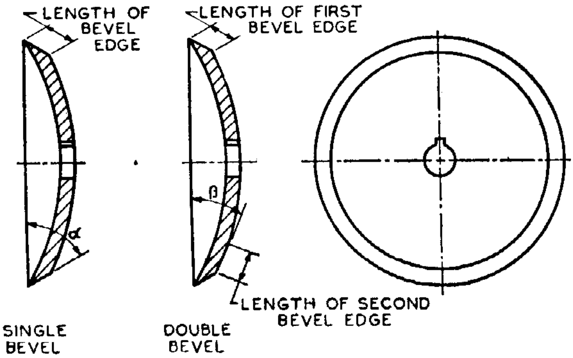
6.1.3 *Thickness of the Cutting Edge* — Measure the thickness of the cutting edge along with the radius of the disc with the help of vernier calliper or point micrometer at four places at a distance of 3 mm from the tip of the edge.

6.1.4 *Length of Bevel Edge* (see *Fig. 1*) — Measure the length of bevel of cutting edge along with the radius of the disc using vernier callipers. It is advisable to take the reading at least four equidistant places. In case of double bevel disc, this should be measured on both sides of the disc.

6.1.5 *Bevel Angle* (see *Fig. 1*) — Measure the bevel angle with the plane of the disc using combination set. It is advisable to take the readings at four equidistant places. In case of disc provided with double bevel, both the bevels shall be measured.

6.1.6 *Centre Hole* (see *Fig. 2*) — The centre hole of the disc should be either square or circular or circular with key way. In case of square hole, all the four sides of the hole should be measured by the vernier calliper or inside micrometer gauge. In case of square hole with round corners, the true radii of roundness of the corners should also be measured along with the sides. In case of circular hole with or without key way, the diameter of the circular hole should be measured by inside micrometer gauge along with the sides of key way.

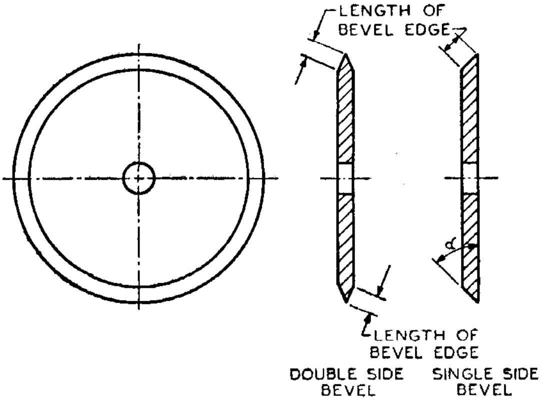
6.1.7 *Concavity* (see *Fig. 3*) — Place the disc in inverted position on a horizontal plane surface. Lower the measuring arm of the depth gauge vertically through the hole of the disc until the arm touches the plane surface. Measure the vertical distance between the plane surface and the position of the centre of the disc on the outside surface. From the distance thus measured, subtract the thickness of the disc to get the value of concavity.



L = First bevel angle

B = Second bevel angle

1A Bevel Length and Angle in Concave Discs



L = Bevel angle

1B Bevel Length and Angle in Flat Discs

FIG. 1 BEVEL LENGTH AND ANGLE OF DISCS

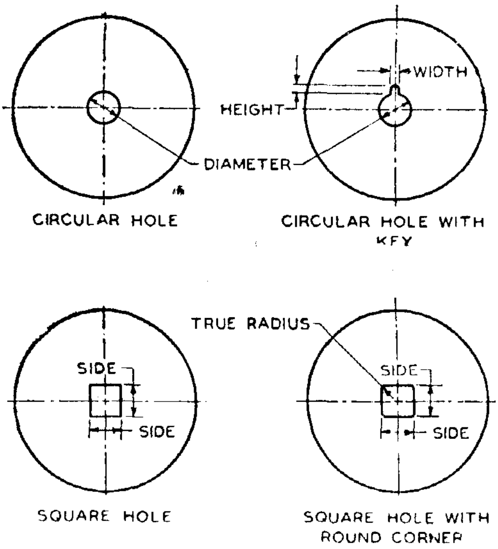
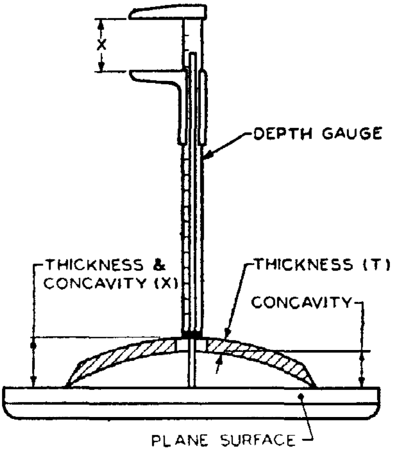


FIG. 2 DISCS WITH DIFFERENT TYPES OF CENTRE HOLES



Concavity = $X - T$

FIG. 3 MEASUREMENT OF CONCAVITY

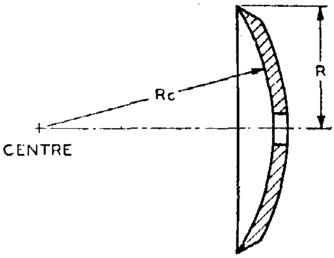
6.1.8 *Radius of Curvature* (see *Fig. 4*) — Calculate the radius of curvature of disc by the following formula:

$$R_c = \frac{R^2 + C^2}{2C}$$

where

R_c = radius of curvature in mm,
R = radius of disc in mm, and
C = concavity of disc in mm.

NOTE — Dimensions given at **6.1.7** and **6.1.8** shall be checked only in case of concave discs.



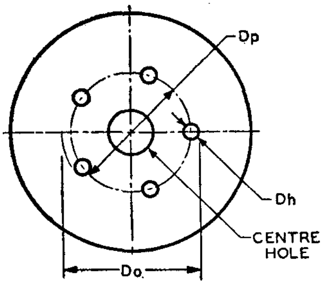
R_c = Radius of curvature
R = Radius of disc

FIG. 4 RADIUS OF CURVATURE OF CONCAVE DISC

6.1.9 *Fixing Holes* (see *Fig. 5*) — Count the number of fixing holes, other than centre hole, provided in the disc. Measure the diameter of each hole at four equidistant places. Average the value which would give the diameter of the hole. The pitch circle diameter of the holes shall also be measured. This shall be measured by vernier callipers. Deduct the diameter of one hole from the measured value for getting pitch circle diameter.

6.1.10 *Notch* (see *Fig. 6*) — Count the number of notch provided in the notched discs. Also measure the width and depth of notch. The width should be measured by placing a measuring rule at the inner points of the one notch at the circumference of the disc. The depth shall be measured by placing a depth gauge at the foot of the each notch to a plane forming the circumference of the disc. The width and depth of each notch should be measured separately.

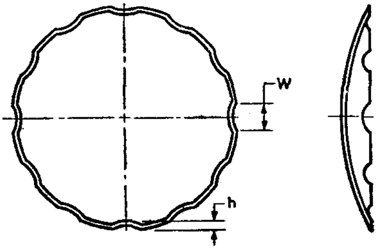
6.1.11 *Mass of Disc* — Take the mass of each disc in grams by placing it on balance of suitable capacity.



Dp = Pitch circle diameter
Do = Distance between outer edges of the hole through centre
Dh = Diameter of fixing hole

$$Dp = Do - Dh$$

FIG. 5 PITCH CIRCLE DIAMETER OF DISC



W = Width of notch
h = Depth of notch

FIG. 6 WIDTH AND DEPTH OF NOTCH

7. FLATNESS, ECCENTRICITY AND WOBBLE

7.1 Flatness — The flatness of flat discs shall be measured by placing the disc on smooth, levelled and flat surface in the horizontal plane. The clearances between the flat surface and the disc near peripheral surface, shall be measured by feeler gauge.

7.2 Eccentricity (*see* Fig. 7) — The disc should be held between spools on a shaft, the shaft should be such that the centre hole of the disc under test should fit properly. The shaft with disc should be mounted between the centres of a rigid mounting. The mounting construction should be similar to that of a lathe. The disc should be able to rotate freely on the mounting.

7.2.1 Set the dial gauge with its shaft perpendicular to disc axis and the pointed end touching the point of start of bevel edge in case of plain discs and the end of the notch in case of notched disc. Rotate the disc at least two revolutions manually. The difference between maximum and minimum readings of the dial gauge gives the value of eccentricity.

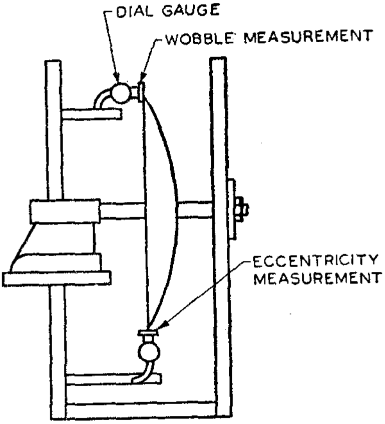


FIG. 7 ECCENTRICITY AND WOBBLE MEASUREMENT

7.3 Wobble (*see* Fig. 7) — Conduct the above test by setting the dial gauge with its shaft parallel to the disc axis.

NOTE — The eccentricity and wobble should be measured in the same setting.

7.4 Record the data in *pro forma* given in Appendix D.

8. HARDNESS

8.1 The disc should be placed on a rigid support. The contact surfaces shall be clean and free from foreign matter, such as scale, oil and dirt. The disc should be supported in such a way that the loading axis is perpendicular to the surface on which load is applied.

8.2 Select at least four equidistant points on the discs, which are located within 50 mm from the outside edge of the disc. The test procedure should be the same as stipulated in IS : 1500-1968* or IS : 1501-1968† or IS : 1586-1968‡.

8.3 For uniformly heat-treated disc, the four points should be selected between the centre of disc and the point (within 50 mm from cutting edge) at which the hardness has already been tested. In all 20 readings should be taken in each disc (*see* Fig. 8).

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*Method for Brinell hardness test for steel (*first revision*).

†Method for Vickers hardness test for steel (*first revision*).

‡Method for Rockwell hardness test (B and C scales) for steel (*first revision*).

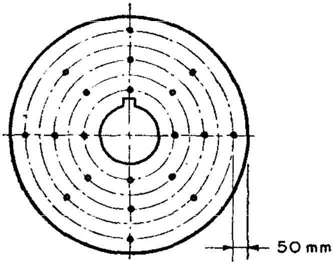

FIG. 8 LOCATION OF POINTS FOR HARDNESS TEST

8.4 For partially hardened disc, twelve points should be selected in hardened zone and eight points in unhardened zone.

8.5 Record the data in *pro forma* given in Appendix E.

9. CHEMICAL COMPOSITION

9.1 Remove paint or any other protective coating from the surface of the disc. Select at least five places on the surface. Drill at selected points. The drilled material should be thoroughly mixed in order to form a composite sample. Take final sample, from this composite sample which would represent the lot, for analysing the chemical composition.

9.2 Analyse the presence and proportion of elements, such as carbon, manganese, silicon, nickel. chromium, sulphur and phosphorus in accordance with IS : 228-1959*. The date should be recorded in *pro forma* given in Appendix F.

NOTE — In case of fully hardened discs, the disc may be softened before drilling.

10. METALLOGRAPHIC TEST

10.1 Three samples, for one disc, one from edge, second from half way from edge to the centre and third from centre of the disc shall be taken for metallographic test.

10.2 Grain size measurement (*see* IS : 2853-1964†) and presences of any non-metallic inclusion (*see* IS : 4163-1967‡) shall be reported in *pro forma* given in Appendix F.

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*Methods of chemical analysis for pig iron, cast iron and plain carbon and low alloy steels (*revised*).

†Method of determining austenitic grain size of steel.

‡Method for determination of inclusion content in steel by microscopic method.

11. DEFLECTION

11.1 The disc should be bolted horizontally after fully supporting its flat centre portion (*see* Fig. 9). The deflection load should be applied on the concave side of the disc at a distance within 25 mm from outer edge of the disc. The load should be gradually increased in 5 steps up to a maximum value as specified in Table 1 for particular size at an interval of 5 minutes each. Corresponding deflection at each load should be measured on a suitably fixed vernier height gauge. The force should be measured by using a portable precision hydraulic dynamometer. Record the deflection at each loading in Appendix G.

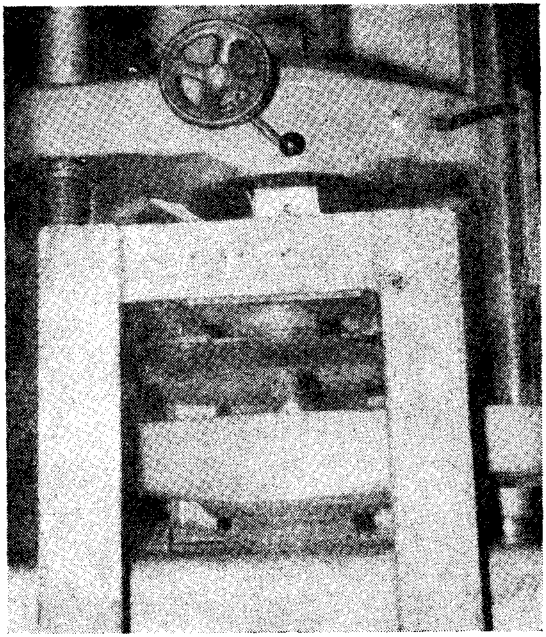

Fig. 9 Deflection Test Set Up

11.2 The loading should now be decreased from maximum to 0 in decrements of 5 steps and the deflection and the load should be recorded in the manner stipulated in **11.1**. Record the data in *pro forma* given in Appendix G.

11.3 Calculate the permanent set or deformation produced due to maximum loading. This should be obtained by deducting the total deflection produced by unloading from the total deflection produced during loading.

TABLE 1 DEFLECTION LOADS FOR DIFFERENT SIZE OF AGRICULTURAL DISCS

Size of Disc (1) mm	Load (2) kN
810	14·70
760	13·72
710	12·74
660	11·76
610	9·80
560	7·84
510	5·88
455	4·41
405	3·43
355	1·96
315	1·96
280	1·96
250	1·96

11.4 A curve should be plotted for deflection against each load for one cycle of loading and unloading. The energy given by the area enclosed by the loading and unloading curves is a representative of fatigue life of disc.

12. IMPACT

12.1 The disc should be rigidly mounted vertically on a rigid frame (*see* Fig. 10). The axis of the disc should be parallel to base of the rigid frame.

12.2 A mass shall be allowed to fall freely on the edge at a height of 200 mm. The height of free fall should be gradually increased in increment of 100 mm, till the disc edge is deformed or broken. The quantity of mass for specific size of disc is given in Table 2.

12.3 The height of free fall at which the disc edge bends or breaks should be recorded in Appendix H.

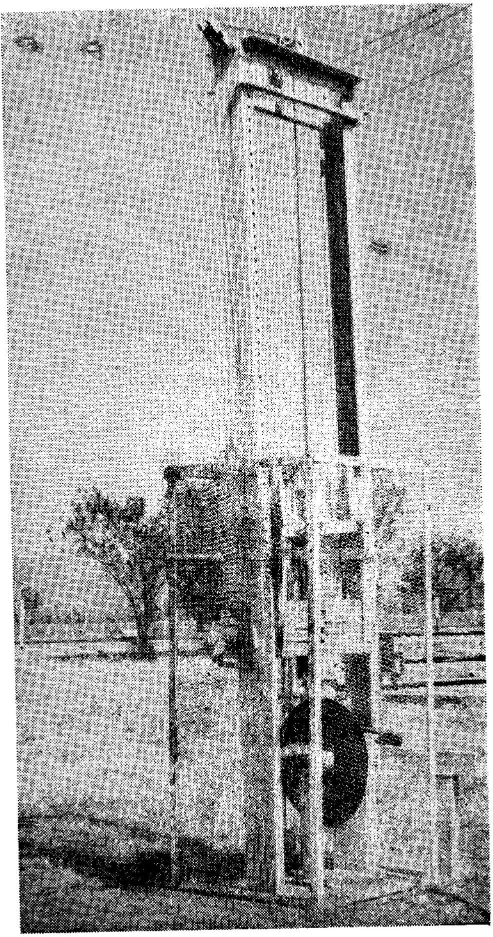

FIG. 10 IMPACT TEST SET UP

TABLE 2 IMPACT LOADS FOR DIFFERENT SIZE OF AGRICULTURAL DISCS

SIZE OF DISC (1) mm	MASS (2) kg
810	150
760	150
710	150
660	100
610	100
560	90
510	80
455	70
405	60
355	50
315	40
280	30
250	20

APPENDIX A

(*Clause* 4.1)

SPECIFICATION SHEET

1. Name of the manufacturer
2. Address of the manufacturer
3. Number of disc handed for testing
4. Type of disc:
    a) Flat
    b) Concave
        i) Plain
        ii) Flat bottom
        iii) Notched

5. Type of centre hole:
    a) Square
    b) Circular
    c) Circular with key way
6. Size of centre hole, mm
7. Number and diameter of fixing holes
8. Pitch circle diameter of fixing holes, mm
9. Size of the disc, mm
10. Concavity, mm
11. Radius of curvature, mm
12. Thickness of edge, mm
13. Type of bevel:
    a) Single side
    b) Double side
    c) Stepped
14. Length of bevel, mm
15. Angle of bevel
16. Size of flat bottom, mm
17. Number of notch
18. Width of notch, mm
19. Depth of notch, mm
20. Material used:
    a) Grade of steel
    b) Composition of element, percent
        i) Carbon
        ii) Silicon
        iii) Manganese
        iv) Sulphur
        v) Phosphorus
        vi) Nickel
        vii) Molybdenum
        viii) Any other

21. Hardness:
    a) Type — Fully hardened or partially hardened
    b) Hardness in hardened zone
    c) Hardness in unhardened zone
22. Mass of disc
23. Implement for which disc is suitable
24. Any instruction to the testing station
25. Disc edge:
    a) Rolled
    b) Machined
26. Any other information

Signature of the manufacturer

APPENDIX B

(*Clause* 5.1)

PRO FORMA FOR VISUAL OBSERVATIONS

1. Number of disc selected for testing
2. Any other accessories received from manufacturer
3. Details of drawings and other literature obtained from manufacturer
4. Visual observations:
    a) Anti-corrosive coating provided
    b) Smoothness of the surface
    c) Presence of scales, pits, cracks, etc, on the surface of disc
    d) Presence of laps, shivers or fins in the cutting edge
    e) Bevel edge is painted or not
    f) Details of the stamping

Testing Engineer

APPENDIX C

(*Clause* 6.1)

PRO FORMA FOR DIMENSIONAL MEASUREMENTS

1. Date of test
2. Dimensions

Sl No.	Sl No. of Disc	Measured Dimensions				Average Dimensions	Variation in Dimensions in Each Disc	Reported Dimensions	Variation in Average Measured and Reported Dimension	Specified Dimension in IS : 4366-1972	Variation in Average Measured and Specified Dimension	Whether Variation is Within the Specified Tolerance or not	Remarks
		1	2	3	4								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)

Testing Engineer

NOTE — The above *pro forma* shall be used for reporting values of each dimension.

APPENDIX D

(*Clause* 7.4)

PRO FORMA FOR FLATNESS, ECCENTRICITY AND WOBBLE TEST

1. Date of test

2. Flatness (for flat discs only)

Sl No.	Sl No. of Test Disc	Diameter of Disc	Measured Flatness	Whether the Maximum Value is Within the Specified Limit or not	Remarks (Whether Localized or Distributed)
(1)	(2)	(3)	(4)	(5)	(6)

3. Eccentricity

Sl No.	Sl No. of Test Disc	Diameter of Disc	Measured Eccentricity	Whether the Maximum Value is Within the Specified Limit or not	Remarks
(1)	(2)	(3)	(4)	(5)	(6)

4. Wobble

Sl No.	Sl No. of Test Disc	Diameter of Disc	Measured Wobble	Whether the Maximum Value is Within the Specified Limit or not	Remarks
(1)	(2)	(3)	(4)	(5)	(6)

Testing Engineer

NOTE 1 — The above *proforma* shall be used for reporting the value of all the discs.

NOTE 2 — The measurement shall be made of all the discs selected for testing.

APPENDIX E

(*Clause* 8.5)

PRO FORMA FOR HARDNESS TEST

1. Date of test
2. Nature of hardness — Fully hardened or partially hardened
3. Ball diameter
4. Load applied

Sl No.	Sl No. of Test Disc	Selected Points on Periphery	Location of Selected Points from Outer Edge in mm	Measured Hardness	Range of Hardness	Reported Hardness	Variation in Reported and Measured Hardness	Specified Hardness	Whether Measured Value is Within the Limit or not	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

Testing Engineer

APPENDIX F

(*Clauses* 9.2 *and* 10.2)

PRO FORMA FOR CHEMICAL COMPOSITION AND METALLOGRAPHIC TEST

1. Date of test
2. No. and Sl No. of disc selected for test
3. Places selected for drilling in disc
4. Quantity obtained from each drilling
5. Quantity of composite sample
6. Quantity of final sample for test

Sl No.	S. No. of Test Disc	Observed Elements with Percentage by Mass		Reported Elements with Percentage		Variation in Measured and Reported Value		IS: Grade of Steel to Which the Observed Value Covers	Whether the Grade Conforms to Specified Value or not	Remarks
		Element	*% by mass*	*Element*	*% by mass*	*Element*	*% by mass*			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)		Carbon		Carbon		Carbon				
ii)		Silicon		Silicon		Silicon				
iii)		Manganese		Manganese		Manganese				
iv)		Sulphur		Sulphur		Sulphur				
v)		Phosphorus		Phosphorus		Phosphorus				
vi)		Nickel		Nickel		Nickel				
vii)		Molybdenum		Molybdenum		Molybdenum				
viii)		Any other		Any other		Any other				

7. Grain size number
8. Presence of any trace of non-metallic inclusions

Testing Engineer

NOTE — The above *pro forma* should be used for all discs to be tested.

APPENDIX G

(*Clause* 11.1)

DEFLECTION TEST DATA

1. Date of test

Sl No. (1)	Sl No. of Test Disc (2)	Distance from Edge at Which the Load was Applied, mm (3)	Load, kN (4)	Deflection, mm		Permanent Set, mm (7)
				Increase load (5)	Decrease load (6)	

Testing Engineer

APPENDIX H

(*Clause* 12.3)

DATA IMPACT TEST

1. Date of test
2. Mass allowed to fall

Sl No. (1)	Sl No. of Test Disc (2)	Height of Fall, mm (3)	Deflection, mm (4)	Condition of Disc Edge (5)
i)		200		
ii)		300		
iii)		400		
iv)		500		
v)		600		
vi)		700		
vii)		800		
viii)		900		
ix)		1000		
x)		1100		
xi)		1200		
xii)		1300		
xiii)		1400		
xiv)		1500		

Testing Engineer